Automated Cost Estimates

ACE

PRESENTATION SYNOPSIS

- Definition
- Purpose
- Products Derived
- Concept
- Assumptions
- Functional Definitions
- Symbolic Equations
- Mathematical Relationships
- Generalized Schematic
- Data Processing Example
- Characteristics
- Reliability

ADDRESS ANY INQUIRIES REGARDING TECHNICAL DETAILS, OR ADDITIONAL COPIES OF THIS BROCHURE, TO:

JAMES A. FLEENER, OR
WAYNE L. JONES
RESEARCH & PLANNING SECTION (AMSMI-IOAR)
TELEPHONE 876-6825

CLEARINGHOUSE FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION CFSTI
DOCUMENT MANAGEMENT BRANCH 410.11

LIMITATIONS IN REPRODUCTION QUALITY

ACCESSION # AD 607268

☑ 1. LEGIBILITY OF THIS DOCUMENT IS IN PART UNSATISFACTORY. REPRODUCTION HAS BEEN MADE FROM THE BEST AVAILABLE COPY.

☐ 2. ORIGINAL DOCUMENT CONTAINS COLOR OTHER THAN BLACK AND WHITE AND IS AVAILABLE IN LIMITED SUPPLY. AFTER PRESENT STOCK IS EXHAUSTED, IT WILL BE AVAILABLE IN BLACK-AND-WHITE ONLY.

☐ 3. THE REPRODUCIBLE QUALITY OF THIS DOCUMENT IS NOT ADEQUATE FOR PUBLIC SALE. AVAILABLE TO CUSTOMERS OF THE DEFENSE DOCUMENTATION CENTER ONLY.

☐ 4. DOCUMENT AVAILABLE FROM CLEARINGHOUSE ON LOAN ONLY (TECHNICAL TRANSLATIONS).

PROCESSOR: [signature]

TSL-107-12/64

DEFINITION

It is a means of forecasting research and development and engineering services cost and direct manhours. More precisely, it is a computer application employing mathematical methods of calculating various cost and DMH relationships and behavior trends; automatically selecting the network that will produce the best calculated forecast based upon historical data.

TREND

RATE OF FIRE PER MINUTE

PURPOSE

Forecast to contractor's estimated contract completion date:

- Cumulative DMH
- Cumulative Dollars — In Relation to Time Periods
- *Overrun/Underrun

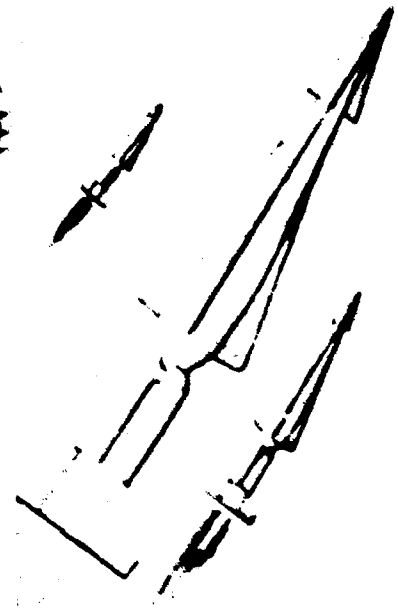
*Dollars/Manhours - provided contractor furnishes an estimate.

WHAT IT DOES

EFFORT

COST

PRODUCT



PRODUCTS DERIVED

CONTRACTOR'S NAME
MISSILE SYSTEM
R & D
TOTAL

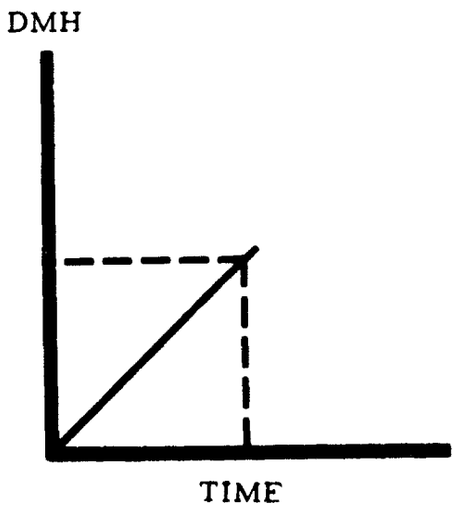
DATE	COST	DMH	$/DMH	% CONTRACT VALUE
		-ACTUAL-		
1 QR 61	$ 1,631.	243.	6.71	.85
2 QR 61	4,654.	542.	8.58	2.44
3 QR 61	10,432.	1,043.	10.00	5.47
4 QR 61	17,445.	1,686.	10.35	9.14
1 QR 62	25,769.	2,495.	10.33	13.51
2 QR 62	36,261.	3,700.	9.80	19.01
3 QR 62	49,150.	4,792.	10.25	25.77
		-FORECAST (ACE)-		
3 QR 62	62,213.	6,067.	10.25	32.62
4 QR 62	76,655.	7,476.	10.25	40.19
1 QR 63	92,444.	9,017.	10.25	48.47
2 QR 63	109,551.	10,678.	10.25	57.44
3 QR 63	127,952.	12,482.	10.25	67.09
4 QR 63	147,625.	14,402.	10.25	77.40
1 QR 64	168,550.	16,44[illegible].	10.25	88.38

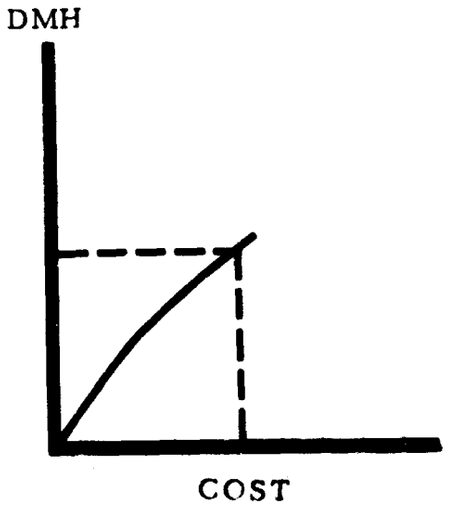
Contract Dollar Value $190,707
Underrun $22,157. beginning 1 QR 64

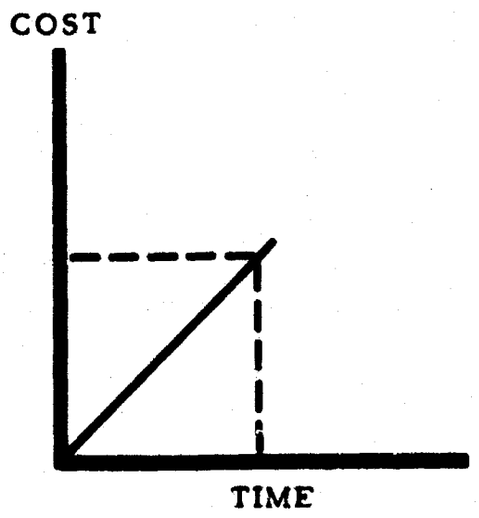
In addition to this report for "Total", the same product can be run for manufacturing, tooling, and engineering, provided the following criteria is adhered to: Direct manhour input is in relation to dollar input for a specific, consistent time period, e.g., total DMH for 1QR61, total dollars for 1QR61. Additional data input requirements: (1) Contractor's estimated completion date; (2) Total contract value.

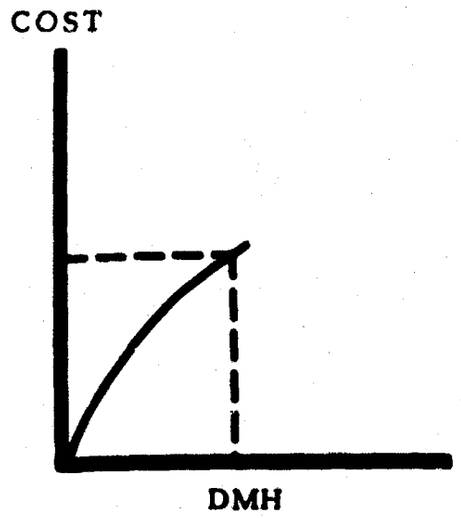
CONCEPT

The concept of ACE evolves from the theory there are significant linear and logarithmic relationships of; direct manhours, dollars and time. A graphic portrayal is the chart shown:



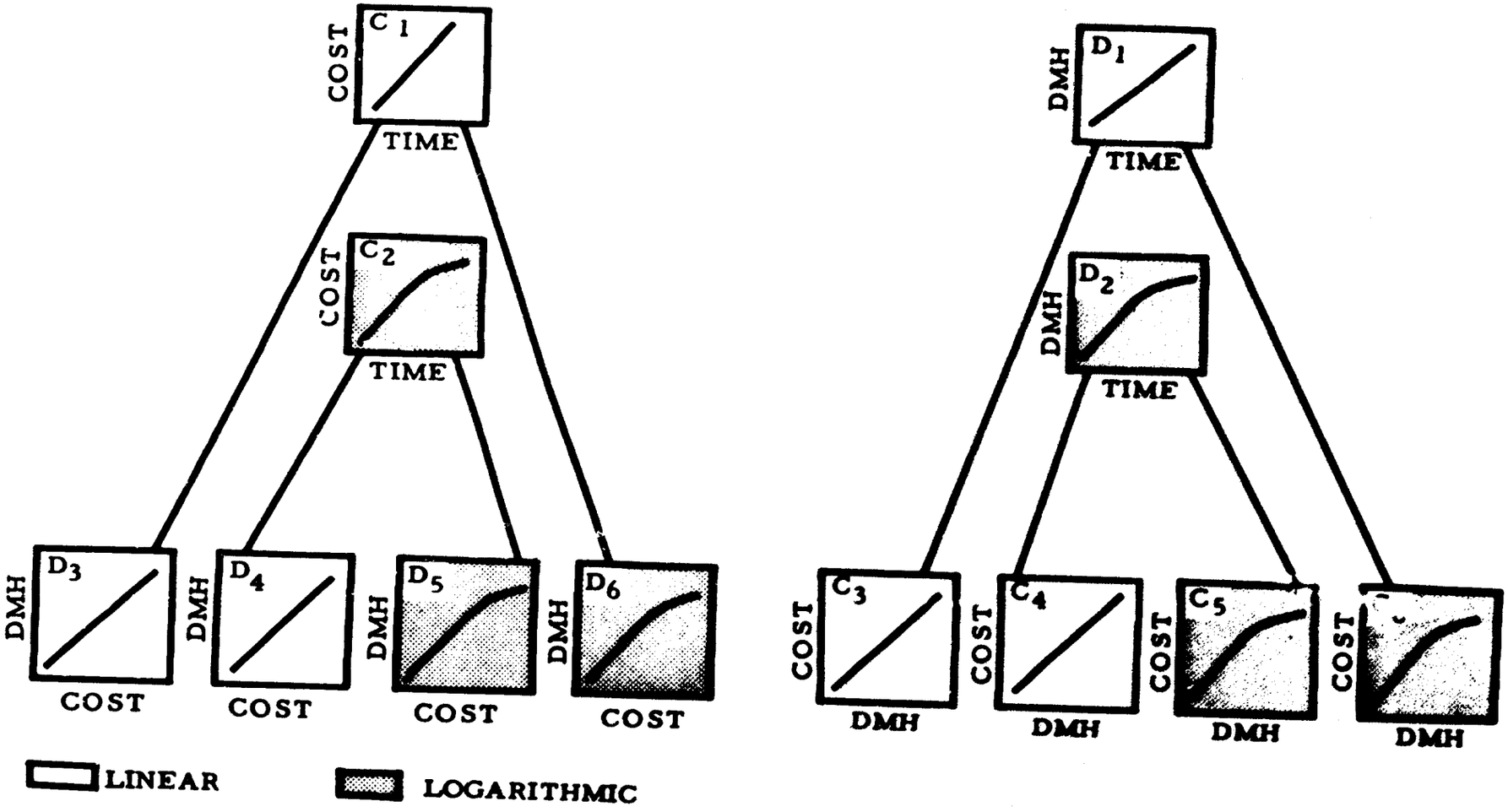






ASSUMPTIONS

Acceptance of the data relationship theorem prompts the assumption this may be expressed schematically as linear and logarithmic relationships:



FUNCTIONAL DEFINITIONS

1. Time = Successive numeric values assigned to each unit (or incremental period) from a specific starting point to a specific ending point; e.g. 3QR60=1, 4 QR60=2, 1QR61=3.

2. Cost = The dollar expenditure for each expression of time.

3. DMH = The direct manhour expenditure for each expression of time.

4. A = The initial value of dollars, direct manhours expended in the first time period, (Intercept).

5. B = The ratio between dollars, DMH, and successive time periods, (Slope).

LINEAR	LOGARITHMIC
A_1 = Time-Cost Initial Value	A_2 = Time-Cost Initial Value
B_1 = Time-Cost Ratio	B_2 = Time-Cost Ratio
A_3 = Time-DMH Initial Value	A_4 = Time-DMH Initial Value
B_3 = Time-DMH Ratio	B_4 = Time-DMH Ratio
A_5 = DMH-Cost Initial Value	A_6 = DMH-Cost Initial Value
B_5 = DMH-Cost Ratio	B_6 = DMH-Cost Ratio
A_7 = Cost-DMH Initial Value	A_8 = Cost-DMH Initial Value
B_7 = Cost-DMH Ratio	B_8 = Cost-DMH Ratio

SYMBOLIC EQUATIONS

N = Number of Points

$$B = \frac{NS^{*}\,XY - SX \cdot SY}{NSX^2 - (SX)^2} \qquad A = \frac{SY - B \cdot SX}{N}$$

$$B_1 = \frac{N \cdot S\,(\text{Time} \cdot \text{Cost}) - S\,(\text{Time}) \cdot S\,(\text{Cost})}{N \cdot S\,(\text{Time})^2 - (S\,(\text{Time}))^2} \qquad A_1 = \frac{S\,(\text{Cost}) - B_1 \cdot S\,(\text{Time})}{N}$$

$$B_2 = \frac{N \cdot S\,(\text{Log Time} \cdot \text{Log Cost}) - S\,(\text{Log Time}) \cdot S\,(\text{Log Cost})}{N \cdot S\,(\text{Log Time})^2 - (S\,(\text{Log Time}))^2}, \quad A_2 = \text{LOG}^{-1}\left(\frac{S\,(\text{Log Cost}) - B_2 \cdot S(\text{Log Time})}{N}\right)$$

$$B_3 = \frac{N \cdot S\,(\text{Time} \cdot \text{DMH}) - S\,(\text{Time}) \cdot S\,(\text{DMH})}{N \cdot S\,(\text{Time})^2 - (S\,(\text{Time}))^2} \qquad A_3 = \frac{S\,(\text{DMH}) - B_3 \cdot S\,(\text{Time})}{N}$$

$$B_4 = \frac{N \cdot S\,(\text{Log Time} \cdot \text{Log DMH}) - S\,(\text{Log Time}) \cdot S\,(\text{Log DMH})}{N \cdot S\,(\text{Log Time})^2 - (S\,(\text{Log Time}))^2}, \quad A_4 = \text{LOG}^{-1}\left(\frac{S\,(\text{Log DMH}) - B_4 \cdot S\,(\text{Log Time})}{N}\right)$$

$$B_5 = \frac{N \cdot S\,(\text{DMH} \cdot \text{Cost}) - S\,(\text{DMH}) \cdot S\,(\text{Cost})}{N \cdot S\,(\text{DMH})^2 - (S\,(\text{DMH}))^2} \qquad A_5 = \frac{S\,(\text{Cost}) - B_5 \cdot S\,(\text{DMH})}{N}$$

$$B_6 = \frac{N \cdot S\,(\text{Log DMH} \cdot \text{Log Cost}) - S\,(\text{Log DMH}) \cdot S\,(\text{Log Cost})}{N \cdot S\,(\text{Log DMH})^2 - (S\,(\text{Log DMH}))^2}, \quad A_6 = \text{LOG}^{-1}\left(\frac{S\,(\text{Log Cost}) - B_6 \cdot S\,(\text{Log DMH})}{N}\right)$$

$$B_7 = \frac{N \cdot S\,(\text{Cost} \cdot \text{DMH}) - S\,(\text{Cost}) \cdot S\,(\text{DMH})}{N \cdot S\,(\text{Cost})^2 - (S\,(\text{Cost}))^2} \qquad A_7 = \frac{S\,(\text{DMH}) - B_7 \cdot S\,(\text{Cost})}{N}$$

$$B_8 = \frac{N \cdot S\,(\text{Log Cost} \cdot \text{Log DMH}) - S\,(\text{Log Cost}) \cdot S\,(\text{Log DMH})}{N \cdot S\,(\text{Log Cost})^2 - (S\,(\text{Log Cost}))^2}, \quad A_8 = \text{LOG}^{-1}\left(\frac{S\,(\text{Log DMH}) - B_8 \cdot S\,(\text{Log Cost})}{N}\right)$$

*S = Summation

MATHEMATICAL RELATIONSHIPS

COST

$C1 = A1 + Time \cdot B1$

$C2 = A2 \cdot (Time)^{B2}$

$(D1) = A3 + Time \cdot B3$

$C3 = A5 + (D1) \cdot B5$

(Time = Any Time Period Specified, Most Commonly Some Future Time Period)

$(D2) = A4 \cdot (Time)^{B4}$

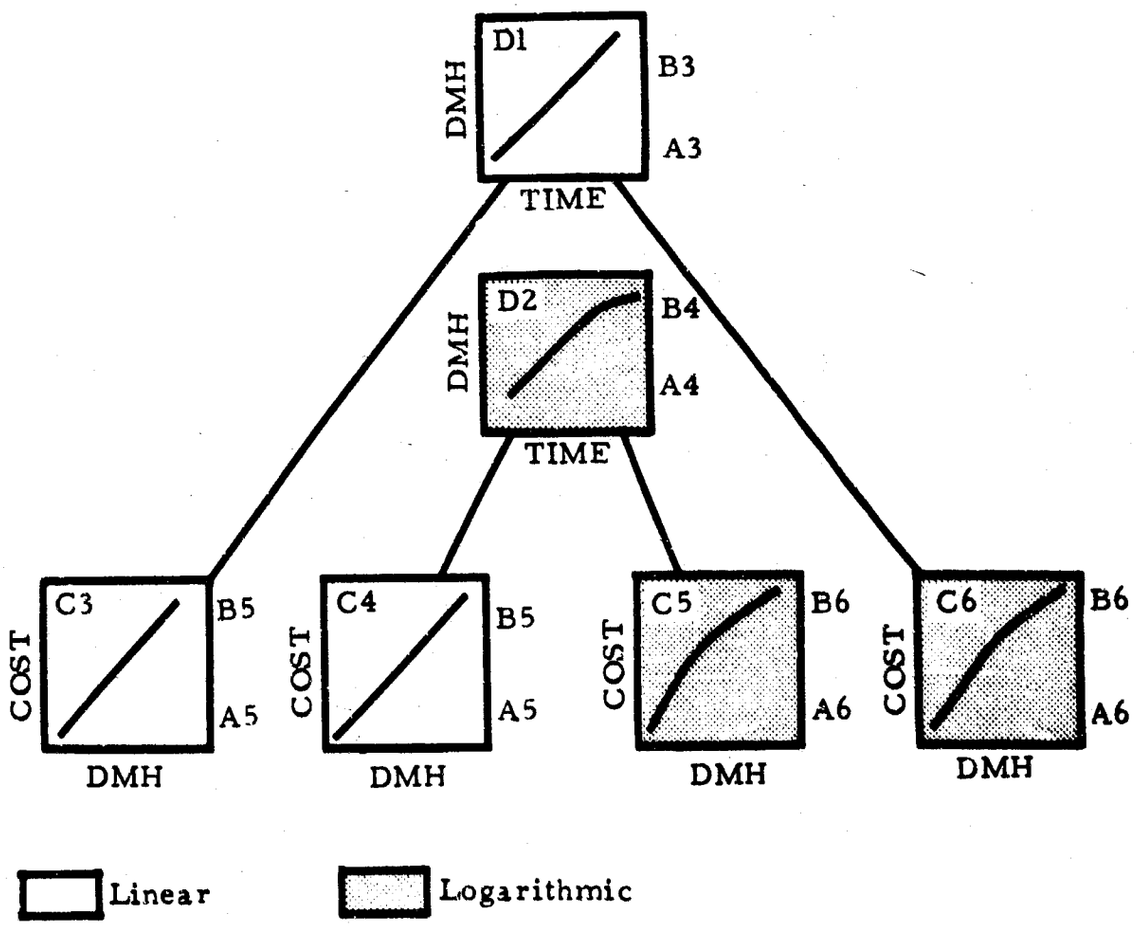
$C4 = A5 + (D2) \cdot B5$

$(D2) = A4 \cdot (Time)^{B4}$

$C5 = A6 \cdot (D2)^{B6}$

$(D1) = A3 + Time \cdot B3$

$C6 = A6 \cdot (D1)^{B6}$



MATHEMATICAL RELATIONSHIPS (CONTINUED)

DIRECT MANHOURS

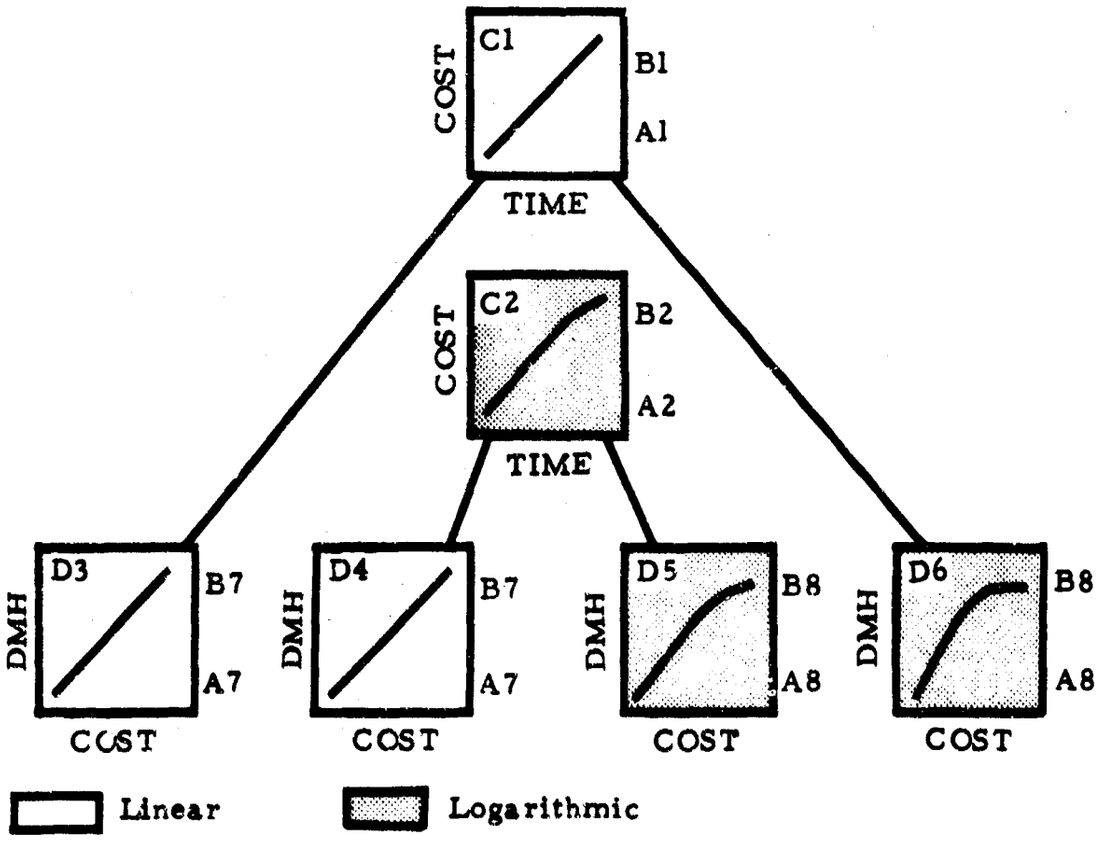
$$D1 = A3 + Time \cdot B3$$
$$D2 = A4 \cdot (Time)^{B4}$$

$$(C1) = A1 + (Time) \cdot B1$$
$$D3 = A7 + (C1) \cdot B7$$

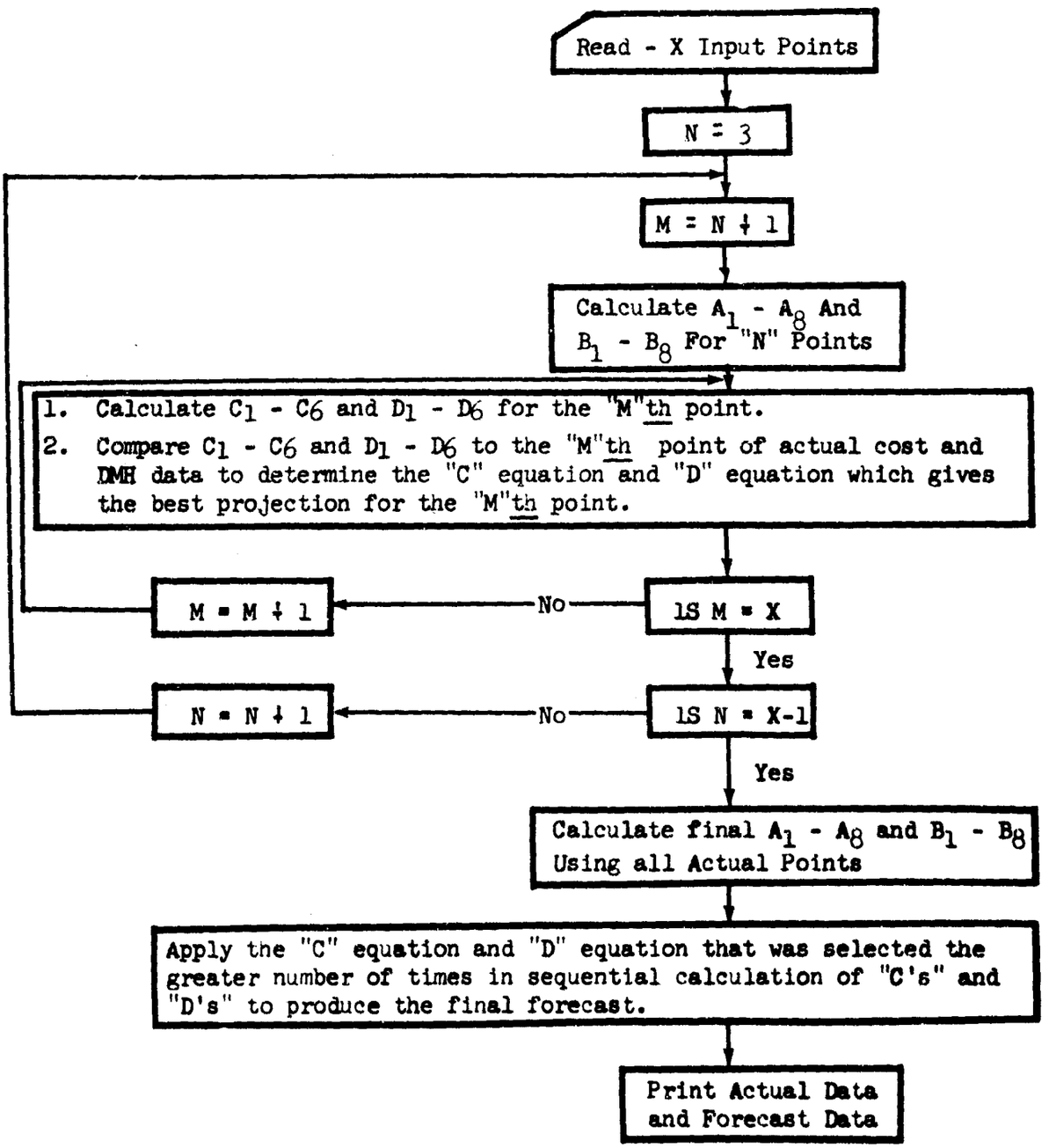
$$(C2) = A2 \cdot (Time)^{B2}$$
$$D4 = A7 + (C2) \cdot B7$$

$$(C2) = A2 \cdot (Time)^{B2}$$
$$D5 = A8 \cdot (C2)^{B8}$$

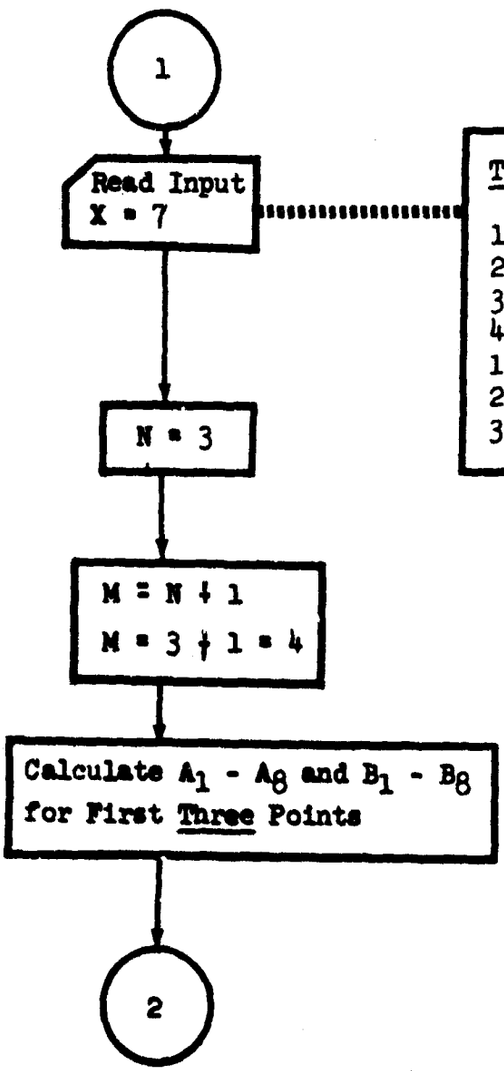
$$(C1) = A1 + (Time) \cdot B1$$
$$D6 = A8 \cdot (C1)^{B8}$$



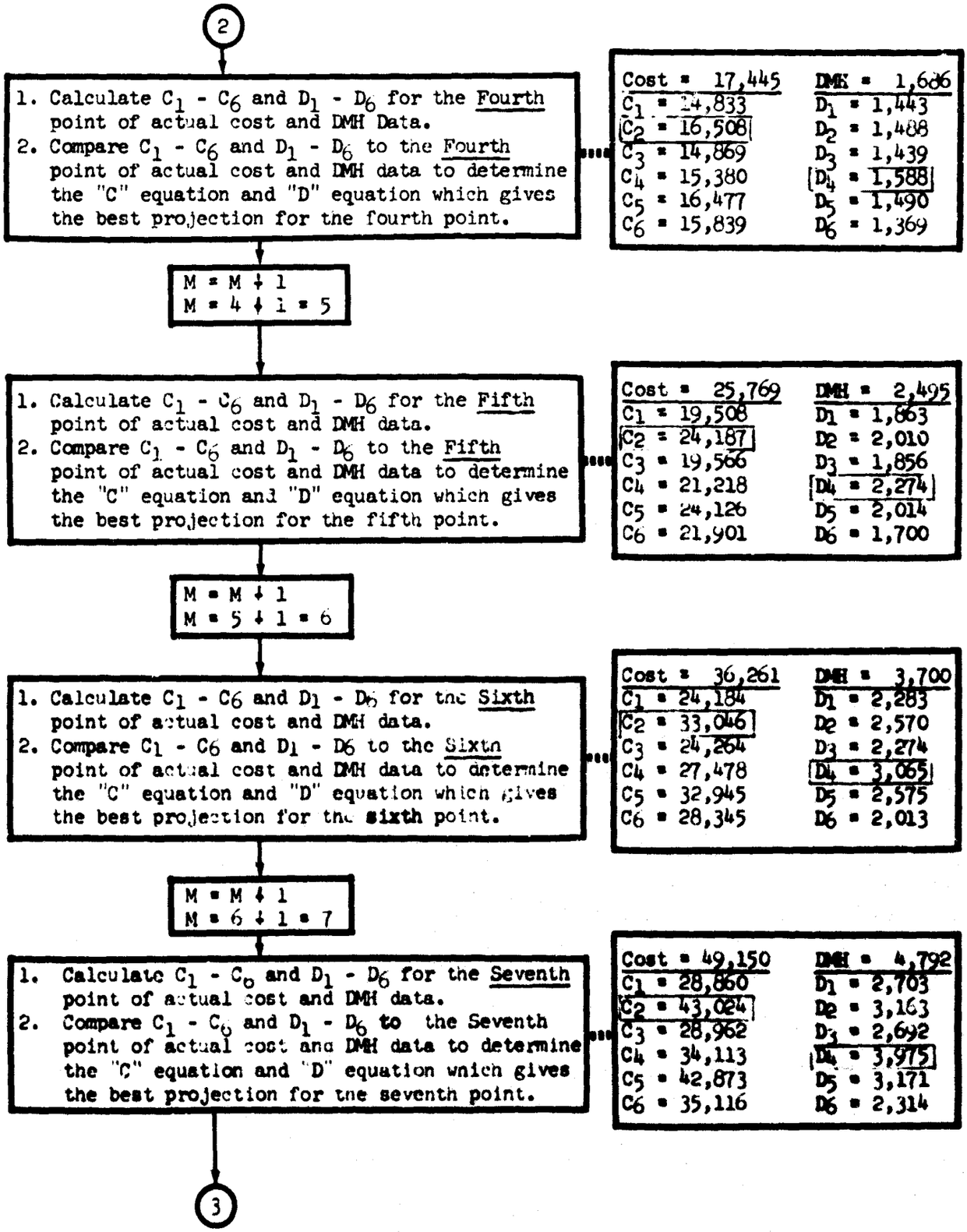
GENERALIZED SCHEMATIC

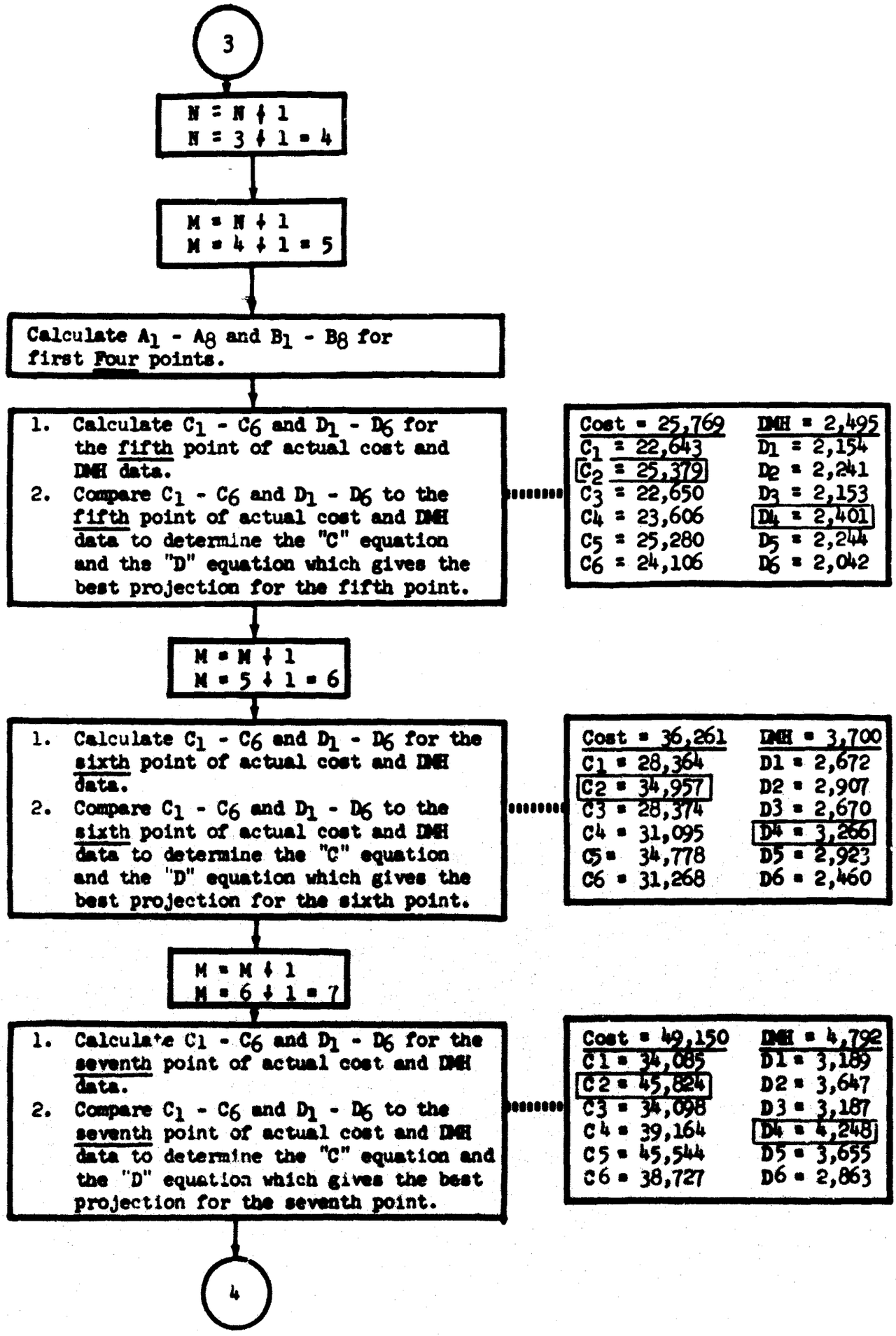


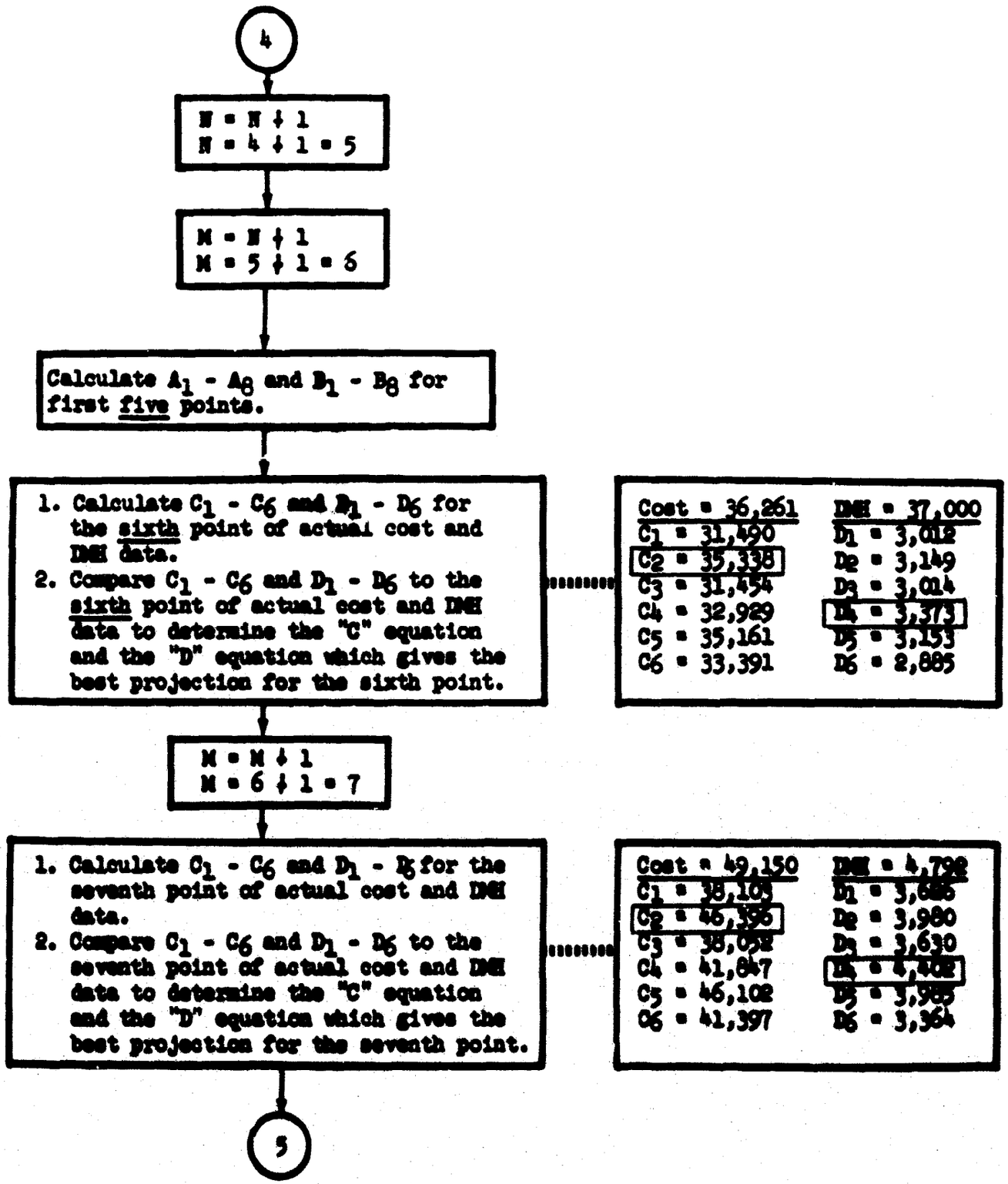
DATA PROCESSING EXAMPLE

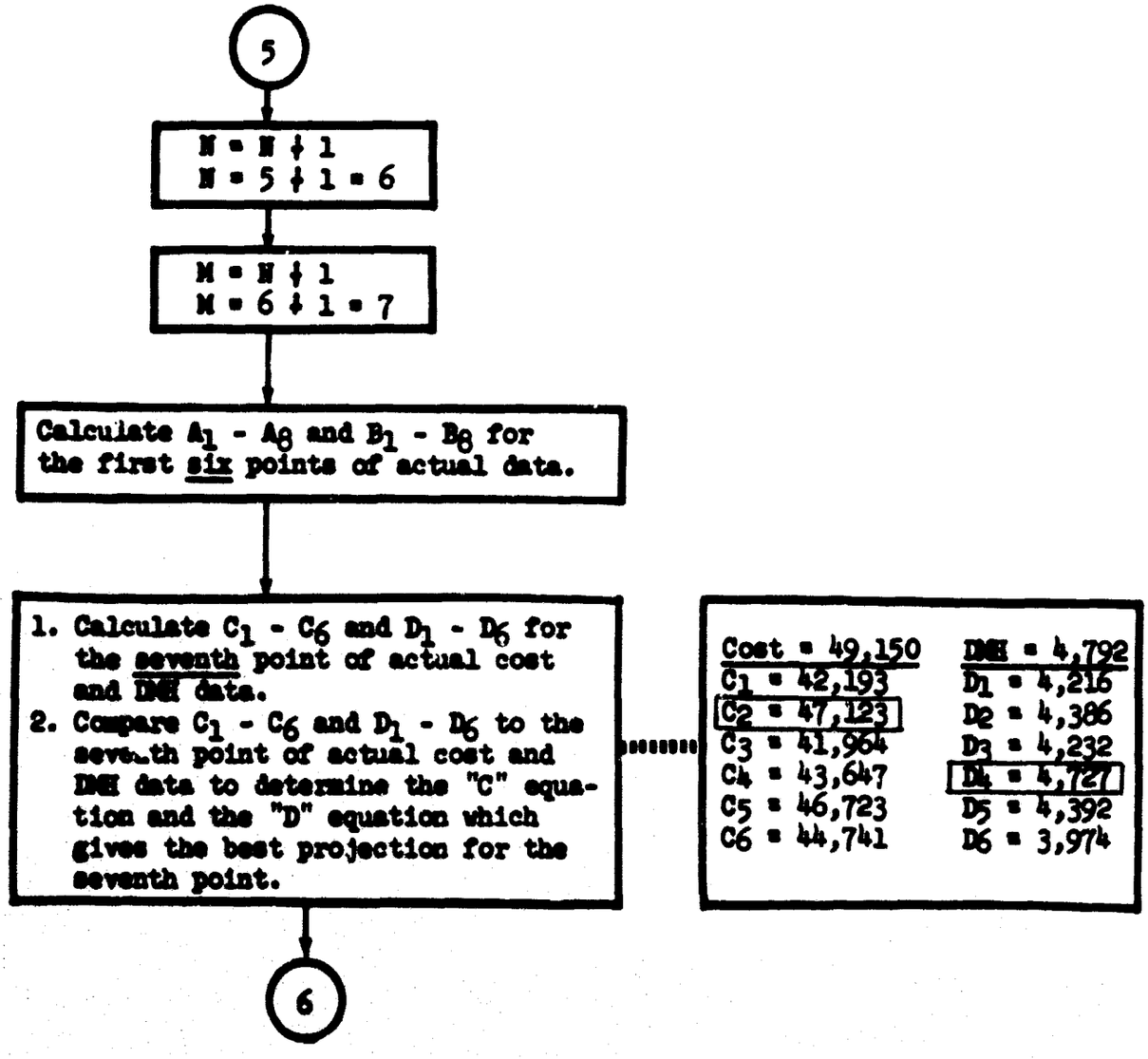


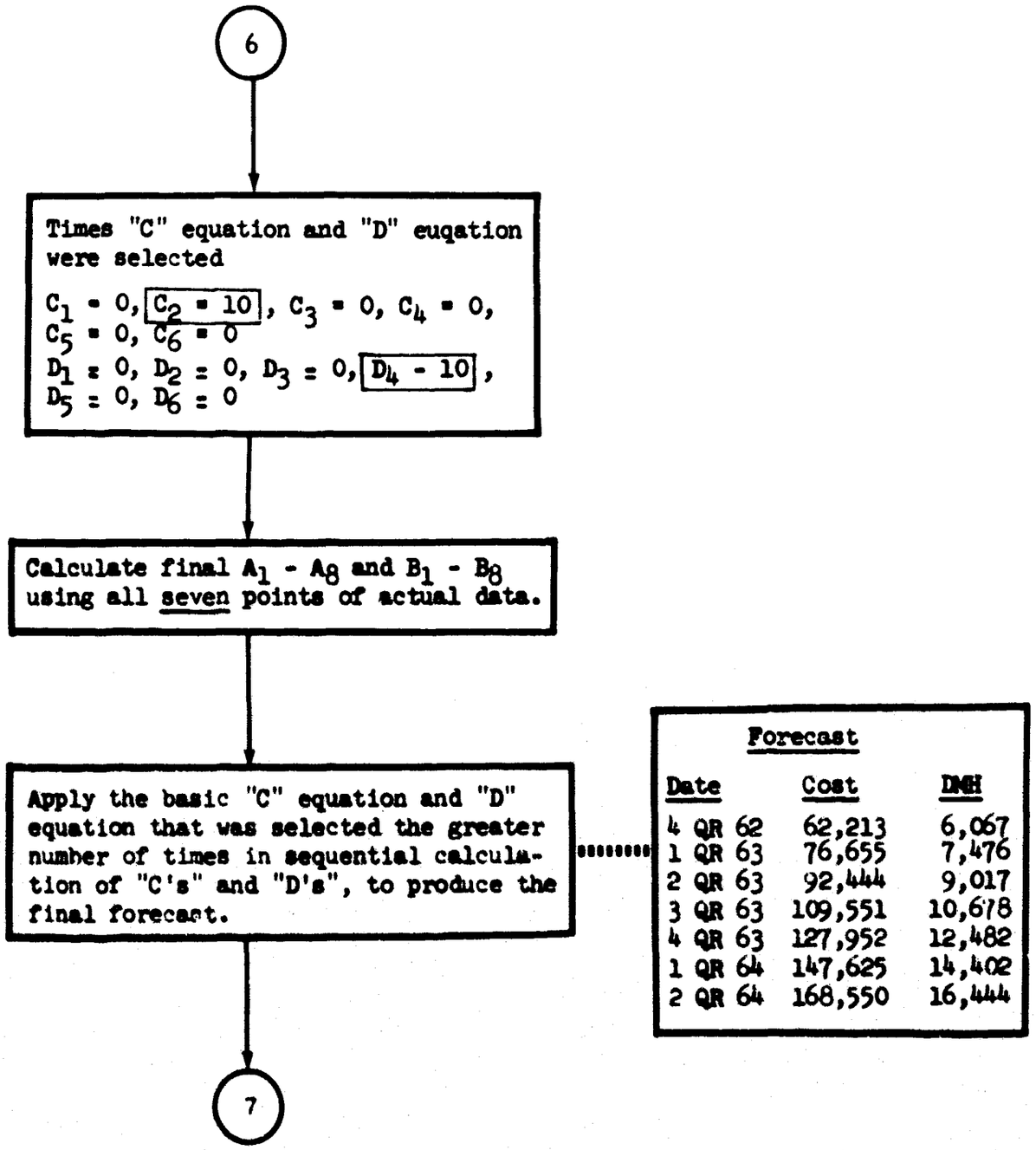
Time Period	Time	Cost	DMH
1 QR 61	1	1,631	234
2 QR 61	2	4,654	542
3 QR 61	3	10,432	1,043
4 QR 61	4	17,445	1,686
1 QR 62	5	25,769	2,495
2 QR 62	6	36,261	3,700
3 QR 62	7	49,150	4,792

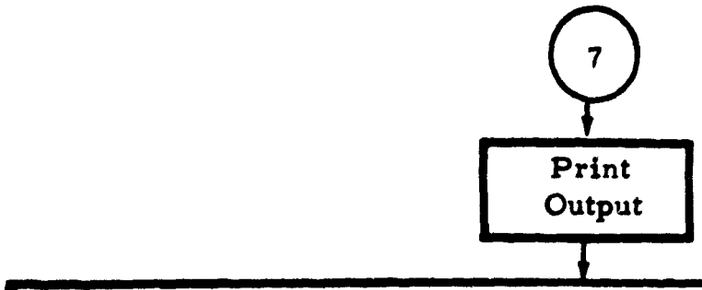

2
1. Calculate C_1 - C_6 and D_1 - D_6 for the Fourth point of actual cost and DMH Data.
2. Compare C_1 - C_6 and D_1 - D_6 to the Fourth point of actual cost and DMH data to determine the "C" equation and "D" equation which gives the best projection for the fourth point.
Cost = 17,445
C_1 = 24,833
C_2 = 16,508
C_3 = 14,869
C_4 = 15,380
C_5 = 16,477
C_6 = 15,839
DMH = 1,686
D_1 = 1,443
D_2 = 1,488
D_3 = 1,439
D_4 = 1,588
D_5 = 1,490
D_6 = 1,369
M = M + 1
M = 4 + 1 = 5
1. Calculate C_1 - C_6 and D_1 - D_6 for the Fifth point of actual cost and DMH data.
2. Compare C_1 - C_6 and D_1 - D_6 to the Fifth point of actual cost and DMH data to determine the "C" equation and "D" equation which gives the best projection for the fifth point.
Cost = 25,769
C_1 = 19,508
C_2 = 24,187
C_3 = 19,566
C_4 = 21,218
C_5 = 24,126
C_6 = 21,901
DMH = 2,495
D_1 = 1,863
D_2 = 2,010
D_3 = 1,856
D_4 = 2,274
D_5 = 2,014
D_6 = 1,700
M = M + 1
M = 5 + 1 = 6
1. Calculate C_1 - C_6 and D_1 - D_6 for the Sixth point of actual cost and DMH data.
2. Compare C_1 - C_6 and D_1 - D_6 to the Sixth point of actual cost and DMH data to determine the "C" equation and "D" equation which gives the best projection for the sixth point.
Cost = 36,261
C_1 = 24,184
C_2 = 33,046
C_3 = 24,264
C_4 = 27,478
C_5 = 32,945
C_6 = 28,345
DMH = 3,700
D_1 = 2,283
D_2 = 2,570
D_3 = 2,274
D_4 = 3,065
D_5 = 2,575
D_6 = 2,013
M = M + 1
M = 6 + 1 = 7
1. Calculate C_1 - C_6 and D_1 - D_6 for the Seventh point of actual cost and DMH data.
2. Compare C_1 - C_6 and D_1 - D_6 to the Seventh point of actual cost and DMH data to determine the "C" equation and "D" equation which gives the best projection for the seventh point.
Cost = 49,150
C_1 = 28,860
C_2 = 43,024
C_3 = 28,962
C_4 = 34,113
C_5 = 42,873
C_6 = 35,116
DMH = 4,792
D_1 = 2,703
D_2 = 3,163
D_3 = 2,692
D_4 = 3,975
D_5 = 3,171
D_6 = 2,314
3


3
N = N + 1
N = 3 + 1 = 4
M = N + 1
M = 4 + 1 = 5
Calculate A1 - A8 and B1 - B8 for first Four points.
1. Calculate C1 - C6 and D1 - D6 for the fifth point of actual cost and DMH data.
2. Compare C1 - C6 and D1 - D6 to the fifth point of actual cost and DMH data to determine the "C" equation and the "D" equation which gives the best projection for the fifth point.
Cost = 25,769
C1 = 22,643
C2 = 25,379
C3 = 22,650
C4 = 23,606
C5 = 25,280
C6 = 24,106
DMH = 2,495
D1 = 2,154
D2 = 2,241
D3 = 2,153
D4 = 2,401
D5 = 2,244
D6 = 2,042
M = M + 1
M = 5 + 1 = 6
1. Calculate C1 - C6 and D1 - D6 for the sixth point of actual cost and DMH data.
2. Compare C1 - C6 and D1 - D6 to the sixth point of actual cost and DMH data to determine the "C" equation and the "D" equation which gives the best projection for the sixth point.
Cost = 36,261
C1 = 28,364
C2 = 34,957
C3 = 28,374
C4 = 31,095
C5 = 34,778
C6 = 31,268
DMH = 3,700
D1 = 2,672
D2 = 2,907
D3 = 2,670
D4 = 3,266
D5 = 2,923
D6 = 2,460
M = M + 1
M = 6 + 1 = 7
1. Calculate C1 - C6 and D1 - D6 for the seventh point of actual cost and DMH data.
2. Compare C1 - C6 and D1 - D6 to the seventh point of actual cost and DMH data to determine the "C" equation and the "D" equation which gives the best projection for the seventh point.
Cost = 49,150
C1 = 34,085
C2 = 45,824
C3 = 34,098
C4 = 39,164
C5 = 45,544
C6 = 38,727
DMH = 4,792
D1 = 3,189
D2 = 3,647
D3 = 3,187
D4 = 4,248
D5 = 3,655
D6 = 2,863
4


4
N = N + 1
N = 4 + 1 = 5
M = M + 1
M = 5 + 1 = 6
Calculate A_1 - A_8 and B_1 - B_8 for first five points.
1. Calculate C_1 - C_6 and D_1 - D_6 for the sixth point of actual cost and DMH data.
2. Compare C_1 - C_6 and D_1 - D_6 to the sixth point of actual cost and DMH data to determine the "C" equation and the "D" equation which gives the best projection for the sixth point.
Cost = 36,261
C_1 = 31,490
C_2 = 35,338
C_3 = 31,454
C_4 = 32,929
C_5 = 35,161
C_6 = 33,391
DMH = 37,000
D_1 = 3,012
D_2 = 3,149
D_3 = 3,014
D_4 = 3,373
D_5 = 3,153
D_6 = 2,885
M = M + 1
M = 6 + 1 = 7
1. Calculate C_1 - C_6 and D_1 - D_6 for the seventh point of actual cost and DMH data.
2. Compare C_1 - C_6 and D_1 - D_6 to the seventh point of actual cost and DMH data to determine the "C" equation and the "D" equation which gives the best projection for the seventh point.
Cost = 49,150
C_1 = 38,105
C_2 = 46,396
C_3 = 38,052
C_4 = 41,847
C_5 = 46,102
C_6 = 41,397
DMH = 4,798
D_1 = 3,686
D_2 = 3,980
D_3 = 3,630
D_4 = 4,402
D_5 = 3,985
D_6 = 3,364
5


5
N = N + 1
N = 5 + 1 = 6
M = N + 1
M = 6 + 1 = 7
Calculate A_1 - A_8 and B_1 - B_8 for the first six points of actual data.
1. Calculate C_1 - C_6 and D_1 - D_6 for the seventh point of actual cost and DME data.
2. Compare C_1 - C_6 and D_1 - D_6 to the seventh point of actual cost and DME data to determine the "C" equation and the "D" equation which gives the best projection for the seventh point.
Cost = 49,150
C_1 = 42,193
C_2 = 47,123
C_3 = 41,964
C_4 = 43,647
C_5 = 46,723
C_6 = 44,741
DME = 4,792
D_1 = 4,216
D_2 = 4,386
D_3 = 4,232
D_4 = 4,727
D_5 = 4,392
D_6 = 3,974
6


6
Times "C" equation and "D" equation were selected
$C_1 = 0$, $C_2 = 10$, $C_3 = 0$, $C_4 = 0$, $C_5 = 0$, $C_6 = 0$
$D_1 = 0$, $D_2 = 0$, $D_3 = 0$, $D_4 - 10$, $D_5 = 0$, $D_6 = 0$
Calculate final A_1 - A_8 and B_1 - B_8 using all seven points of actual data.
Apply the basic "C" equation and "D" equation that was selected the greater number of times in sequential calculation of "C's" and "D's", to produce the final forecast.
7
Forecast
Date Cost DMH
4 QR 62 62,213 6,067
1 QR 63 76,655 7,476
2 QR 63 92,444 9,017
3 QR 63 109,551 10,678
4 QR 63 127,952 12,482
1 QR 64 147,625 14,402
2 QR 64 168,550 16,444



CONTRACTOR'S NAME
MISSILE SYSTEM
R & D
TOTAL

-ACTUAL-

DATE	COST	DMH	$/DMH	% CONTRACT VALUE
1 QR 61	$ 1,631.	243.	6.71	.85
2 QR 61	4,654.	542.	8.58	2.44
3 QR 61	10,432.	1,043.	10.00	5.47
4 QR 61	17,445.	1,686.	10.35	9.14
1 QR 62	25,769.	2,495.	10.33	13.51
2 QR 62	36,261.	3,700.	9.80	19.01
3 QR 62	49,150.	4,792.	10.25	25.77

-FORECAST (ACE)-

3 QR 62	62,213.	6,067.	10.25	32.62
4 QR 62	76,655.	7,476.	10.25	40.19
1 QR 63	92,444.	9,017.	10.25	48.47
2 QR 63	109,551.	10,678.	10.25	57.44
3 QR 63	127,952.	12,482.	10.25	67.09
4 QR 63	147,625.	14,402.	10.25	77.40
1 QR 64	168,550.	16,444.	10.25	88.38

Contract Dollar Value $190,707.
Underrun $22,157. beginning 1 QR 64

If a comparison of previous forecasts is desired, the following output is available.

Percent Variance of Previous Forecast from Subsequent Actual

Date	Cost	DMH
1 QR 62	- 5.47	- 9.81
2 QR 62	- 3.60	- 11.73
3 QR 62	- 6.77	- 11.35
2 QR 62	- 2.55	- 8.84
3 QR 62	- 5.00	- 8.14
3 QR 62	- 4.12	- 1.36

CHARACTERISTICS

* Generally, the best dollar forecast is obtained by using a DMH-Time Base.
* Generally, the best DMH forecast is obtained by using a Dollar-Time Base.
* In many cases calculated forecast does not flatten out nearing the completion of a contract, as does the actual cost or DMH.
* Trend values are adversely affected by erratic data - especially by negative input points.

RELIABILITY

GENERALLY

DMH ± 2% ERROR

DOLLARS ± 3-5% ERROR

The confidence level expressed here will be gradually improved as experience enables development of more sophisticated techniques. It has been proved that the present products are more valid than any currently available. Predicated on the assumption that the future data behavior will generally follow that of the actual, it is a positive fact that ACE forecasts will be extremely useful in making management decisions.

Improvements, refinements, and expansions are in development, and will be made available as rapidly as possible.

APPENDIX I

EXAMPLE OF ACE COMPUTER OUTPUT USING CONTRACTOR DATA

CONTRACTOR
CONTRACT NUMBER
SYSTEM
FUNCTION

....ACTUAL....

DATE	COST	D.M.H.	$/DMH
1 QR 61	1,631,795.	0 243,250.	6.71
2 QR 61	4,654,091.	0 542,600.	8.58
3 QR 61	10,432,464.	1,043,100.	10.00
4 QR 61	17,445,311.	1,686,100.	10.35
1 QR 62	25,769,096.	2,495,000.	10.33
2 QR 62	36,261,000.	3,700,000.	9.80
3 QR 62	49,150,000.	4,792,800.	10.25
4 QR 62	62,278,000.	5,965,683.	10.44
1 QR 63	75,685,000.	7,257,681.	10.43
2 QR 63	90,405,000.	8,713,017.	10.38
3 QR 63	108,227,000.	10,405,355.	10.40
2 4 WTD.			

....FORECAST....

4 QR 63	126,613,116.	12,157,030.	10.41
1 QR 64	146,267,756.	14,029,536.	10.43
2 QR 64	167,170,013.	16,020,952.	10.43
3 QR 64	189,302,136.	18,129,527.	10.44
4 QR 64	212,647,683.	20,353,652.	10.45
1 QR 65	237,189,853.	22,691,840.	10.45
2 QR 65	262,914,458.	25,142,722.	10.46
3 QR 65	289,809,367.	27,705,009.	10.46
4 QR 65	317,860,199.	30,377,505.	10.46
1 QR 66	347,057,273.	33,159,083.	10.47
2 QR 66	377,387,809.	36,048,684.	10.47
3 QR 66	408,840,178.	39,045,308.	10.47
4 QR 66	441,407,879.	42,147,000.	10.47
1 QR 67	475,078,574.	45,355,869.	10.47

C 0 29 0 0 1 0
D 0 0 0 36 0 0

CONTRACTOR
CONTRACT NUMBER
SYSTEM
FUNCTION

....ACTUAL....

DATE	COST	D.M.H.	$/DMH
1 QR 61	1,631,795.	0 243,250.	6.71
2 QR 61	4,654,091.	0 542,600.	8.58
3 QR 61	10,432,464.	1,043,100.	10.00
4 QR 61	17,445,311.	1,686,100.	10.35
1 QR 62	25,769,096.	2,495,000.	10.33
2 QR 62	36,261,000.	3,700,000.	9.80
3 QR 62	49,150,000.	4,792,800.	10.25
4 QR 62	62,278,000.	5,965,683.	10.44
1 QR 63	75,685,000.	7,257,681.	10.43
2 QR 63	90,405,000.	8,713,017.	10.38
2 4 WTD.		....FORECAST....	
3 QR 63	107,524,586.	10,342,024.	10.40
	-0.65	-0.61	
4 QR 63	125,938,198.	12,094,164.	10.41
1 QR 64	145,623,775.	13,967,316.	10.43
2 QR 64	166,560,263.	15,959,566.	10.44
3 QR 64	188,730,389.	18,069,167.	10.44
4 QR 64	212,117,726.	20,294,517.	10.45
1 QR 65	236,704,487.	22,634,133.	10.46
2 QR 65	262,478,485.	25,086,647.	10.46
3 QR 65	289,425,495.	27,650,780.	10.47
4 QR 65	317,533,356.	30,325,332.	10.47
1 QR 66	346,789,382.	33,109,185.	10.47
2 QR 66	377,183,798.	36,001,282.	10.48
3 QR 66	408,703,972.	39,000,621.	10.48
4 QR 66	441,341,421.	42,106,258.	10.48
1 QR 67	475,087,794.	45,317,297.	10.48

C 0 24 0 0 4 0
D 0 0 0 28 0 0

CONTRACTOR
CONTRACT NUMBER
SYSTEM
FUNCTION

....ACTUAL....

DATE	COST	D.M.H.	$/DMH
1 QR 61	1,631,795.	0 243,250.	6.71
2 QR 61	4,654,091.	0 542,600.	8.58
3 QR 61	10,432,464.	1,043,100.	10.00
4 QR 61	17,445,311.	1,686,100.	10.35
1 QR 62	25,769,096.	2,495,000.	10.33
2 QR 62	36,261,000.	3,700,000.	9.80
3 QR 62	49,150,000.	4,792,800.	10.25
4 QR 62	62,278,000.	5,965,683.	10.44
1 QR 63	75,685,000.	7,257,681.	10.43
2 4 WTD.			

....FORECAST....

2 QR 63	91,625,906.	8,768,685.	10.45
	1.35	0.64	
3 QR 63	108,907,820.	10,406,800.	10.47
	0.63	0.01	
4 QR 63	127,506,238.	12,169,704.	10.48
1 QR 64	147,399,590.	14,055,313.	10.49
2 QR 64	168,566,387.	16,061,744.	10.49
3 QR 64	190,990,454.	18,187,279.	10.50
4 QR 64	214,654,461.	20,430,340.	10.51
1 QR 65	239,543,706.	22,789,466.	10.51
2 QR 65	265,642,104.	25,263,314.	10.51
3 QR 65	292,937,484.	27,850,617.	10.52
4 QR 65	321,418,539.	30,550,196.	10.52
1 QR 66	351,071,810.	33,360,948.	10.52
2 QR 66	381,886,550.	36,281,831.	10.53
3 QR 66	413,852,143.	39,311,854.	10.53
4 QR 66	446,960,137.	42,450,088.	10.53
1 QR 67	481,200,193.	45,695,645.	10.53

C 0 20 0 0 1 0
D 0 0 0 21 0 0

CONTRACTOR
CONTRACT NUMBER
SYSTEM
FUNCTION

....ACTUAL....

DATE	COST	D.M.H.	$/DMH
1 QR 61	1,631,795.	0 243,250.	6.71
2 QR 61	4,654,091.	0 542,600.	8.58
3 QR 61	10,432,464.	1,043,100.	10.00
4 QR 61	17,445,311.	1,686,100.	10.35
1 QR 62	25,769,096.	2,495,000.	10.33
2 QR 62	36,261,000.	3,700,000.	9.80
3 QR 62	49,150,000.	4,792,800.	10.25
4 QR 62	62,278,000.	5,965,683.	10.44
2 4 WTD.		....FORECAST....	
1 QR 63	76,907,661.	7,359,550.	10.45
	1.62	1.40	
2 QR 63	92,916,151.	8,884,788.	10.46
	2.78	1.97	
3 QR 63	110,276,034.	10,538,782.	10.46
	1.89	1.28	
4 QR 63	128,962,974.	12,319,214.	10.47
1 QR 64	148,955,558.	14,224,001.	10.47
2 QR 64	170,232,349.	16,251,261.	10.48
3 QR 64	192,777,862.	18,399,279.	10.48
4 QR 64	216,573,811.	20,666,476.	10.48
1 QR 65	241,605,535.	23,051,393.	10.48
2 QR 65	267,857,963.	25,552,681.	10.48
3 QR 65	295,318,740.	28,169,080.	10.48
4 QR 65	323,975,935.	30,899,407.	10.48
1 QR 66	353,816,173.	33,742,557.	10.49
2 QR 66	384,830,720.	36,697,490.	10.49
3 QR 66	417,007,978.	39,763,214.	10.49
4 QR 66	450,337,495.	42,938,797.	10.49
1 QR 67	484,811,946.	46,223,350.	10.49

C 0 15 0 0 0 0
D 0 0 0 15 0 0

CONTRACTOR
CONTRACT NUMBER
SYSTEM
FUNCTION

DATE	COST	D.M.H.	$/DMH
	....ACTUAL....		
1 QR 61	1,631,795.	0 243,250.	6.71
2 QR 61	4,654,091.	0 542,600.	8.58
3 QR 61	10,432,464.	1,043,100.	10.00
4 QR 61	17,445,311.	1,686,100.	10.35
1 QR 62	25,769,096.	2,495,000.	10.33
2 QR 62	36,261,000.	3,700,000.	9.80
3 QR 62	49,150,000.	4,792,800.	10.25
2 4 WTD.			
	....FORECAST....		
4 QR 62	62,213,492.	6,067,584.	10.25
	-0.10	1.71	
1 QR 63	76,655,565.	7,476,895.	10.25
	1.28	3.02	
2 QR 63	92,444,242.	9,017,612.	10.25
	2.26	3.50	
3 QR 63	109,551,587.	10,687,010.	10.25
	1.22	2.71	
4 QR 63	127,952,825.	12,482,670.	10.25
1 QR 64	147,625,859.	14,402,424.	10.25
2 QR 64	168,550,103.	16,444,313.	10.25
3 QR 64	190,707,994.	18,606,551.	10.25
4 QR 64	214,082,121.	20,887,497.	10.25
1 QR 65	238,657,715.	23,285,634.	10.25
2 QR 65	264,419,609.	25,799,564.	10.25
3 QR 65	291,354,542.	28,427,976.	10.25
4 QR 65	319,449,434.	31,169,645.	10.25
1 QR 66	348,694,541.	34,023,424.	10.25
2 QR 66	379,076,101.	36,988,235.	10.25
3 QR 66	410,585,480.	40,063,050.	10.25
4 QR 66	443,212,196.	43,246,900.	10.25
1 QR 67	476,947,915.	46,538,873.	10.25

C 0 10 0 0 0 0
D 0 0 0 10 0 0

CONTRACTOR
CONTRACT NUMBER
SYSTEM
FUNCTION

....ACTUAL....

DATE	COST	D.M.H.	$/DMH
1 QR 61	1,631,795.	0 243,250.	6.71
2 QR 61	4,654,091.	0 542,600.	8.58
3 QR 61	10,432,464.	1,043,100.	10.00
4 QR 61	17,445,311.	1,686,100.	10.35
1 QR 62	25,769,096.	2,495,000.	10.33
2 QR 62	36,261,000.	3,700,000.	9.80
2 4 WTD.			

....FORECAST....

3 QR 62	47,572,727.	4,837,438.	9.83
	-3.21	0.93	
4 QR 62	60,222,005.	6,109,373.	9.86
	-3.30	2.41	
1 QR 63	74,170,087.	7,511,907.	9.87
	-2.00	3.50	
2 QR 63	89,383,747.	9,041,700.	9.89
	-1.13	3.77	
3 QR 63	105,834,033.	10,695,840.	9.89
	-2.21	2.79	
4 QR 63	123,495,309.	12,471,751.	9.90
1 QR 64	142,344,323.	14,367,125.	9.91
2 QR 64	162,361,676.	16,379,883.	9.91
3 QR 64	183,526,295.	18,508,151.	9.92
4 QR 64	205,823,545.	20,750,131.	9.92
1 QR 65	229,234,455.	23,104,281.	9.92
2 QR 65	253,747,683.	25,569,104.	9.92
3 QR 65	279,346,674.	28,143,217.	9.93
4 QR 65	306,020,022.	30,825,331.	9.93
1 QR 66	333,755,885.	33,614,239.	9.93
2 QR 66	362,541,438.	36,508,805.	9.93
3 QR 66	392,368,001.	39,507,951.	9.93
4 QR 66	423,224,054.	42,610,664.	9.93
1 QR 67	455,100,217.	45,815,986.	9.93

C 0 6 0 0 0 0
D 0 0 0 6 0 0

CONTRACTOR
CONTRACT NUMBER
SYSTEM
FUNCTION

DATE	COST	D.M.H.	$/DMH
	....ACTUAL....		
1 QR 61	1,631,795.	0 243,250.	6.71
2 QR 61	4,654,091.	0 542,600.	8.58
3 QR 61	10,432,464.	1,043,100.	10.00
4 QR 61	17,445,311.	1,686,100.	10.35
1 QR 62	25,769,096.	2,495,000.	10.33
2 4 WTD.	....FORECAST....		
2 QR 62	35,498,218.	3,400,573.	10.44
	-2.10	-8.09	
3 QR 62	46,556,587.	4,429,870.	10.51
	-5.28	-7.57	
4 QR 62	58,896,929.	5,578,491.	10.56
	-5.43	-6.49	
1 QR 63	72,479,683.	6,842,754.	10.59
	-4.24	-5.72	
2 QR 63	87,271,004.	8,219,509.	10.62
	-3.47	-5.66	
3 QR 63	103,241,426.	9,706,013.	10.64
	-4.61	-6.72	
4 QR 63	120,364,913.	11,299,842.	10.65
1 QR 64	138,618,096.	12,998,831.	10.66
2 QR 64	157,980,148.	14,801,028.	10.67
3 QR 64	178,432,094.	16,704,660.	10.68
4 QR 64	199,956,186.	18,708,100.	10.69
1 QR 65	222,536,377.	20,809,849.	10.69
2 QR 65	246,158,260.	23,008,529.	10.70
3 QR 65	270,807,952.	25,302,849.	10.70
4 QR 65	296,471,916.	27,691,604.	10.71
1 QR 66	323,138,509.	30,173,671.	10.71
2 QR 66	350,795,890.	32,747,994.	10.71
3 QR 66	379,433,369.	35,413,569.	10.71
4 QR 66	409,041,402.	38,169,451.	10.72
1 QR 67	439,610,607.	41,014,753.	10.72

C 0 3 0 0 0 0
D 0 0 0 3 0 0

CONTRACTOR
CONTRACT NUMBER
SYSTEM
FUNCTION

DATE	COST	D.M.H.	$/DMH
	....ACTUAL....		
1 QR 61	1,631,795.	0 243,250.	6.71
2 QR 61	4,654,091.	0 542,600.	8.58
3 QR 61	10,432,464.	1,043,100.	10.00
4 QR 61	17,445,311.	1,686,100.	10.35
2 4 WTD.	....FORECAST....		
1 QR 62	25,673,453.	2,429,439.	10.57
	-3.37	-2.63	
2 QR 62	35,250,938.	3,294,679.	10.70
	-2.79	-10.95	
3 QR 62	46,118,665.	4,276,481.	10.78
	-6.17	-10.77	
4 QR 62	58,228,806.	5,370,524.	10.84
	-6.50	-9.98	
1 QR 63	71,541,394.	6,573,198.	10.88
	-5.47	-9.45	
2 QR 63	86,022,274.	7,881,416.	10.91
	-4.85	-9.54	
3 QR 63	101,641,754.	9,292,496.	10.94
	-6.08	-10.70	
4 QR 63	118,373,628.	10,804,072.	10.96
1 QR 64	136,194,238.	12,414,026.	10.97
2 QR 64	155,083,615.	14,120,456.	10.98
3 QR 64	175,020,387.	15,921,635.	10.99
4 QR 64	195,989,767.	17,815,975.	11.00
1 QR 65	217,973,702.	19,802,021.	11.01
2 QR 65	240,957,756.	21,878,450.	11.01
3 QR 65	264,927,989.	24,043,948.	11.02
4 QR 65	289,871,958.	26,297,402.	11.02
1 QR 66	315,777,259.	28,637,706.	11.03
2 QR 66	342,632,054.	31,063,831.	11.03
3 QR 66	370,426,644.	33,574,803.	11.03
4 QR 66	399,150,502.	36,169,709.	11.04
1 QR 67	428,792,240.	38,847,684.	11.04

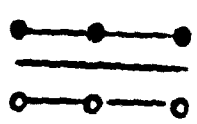
C 0 1 0 0 0 0
D 0 0 0 1 0 0

APPENDIX II

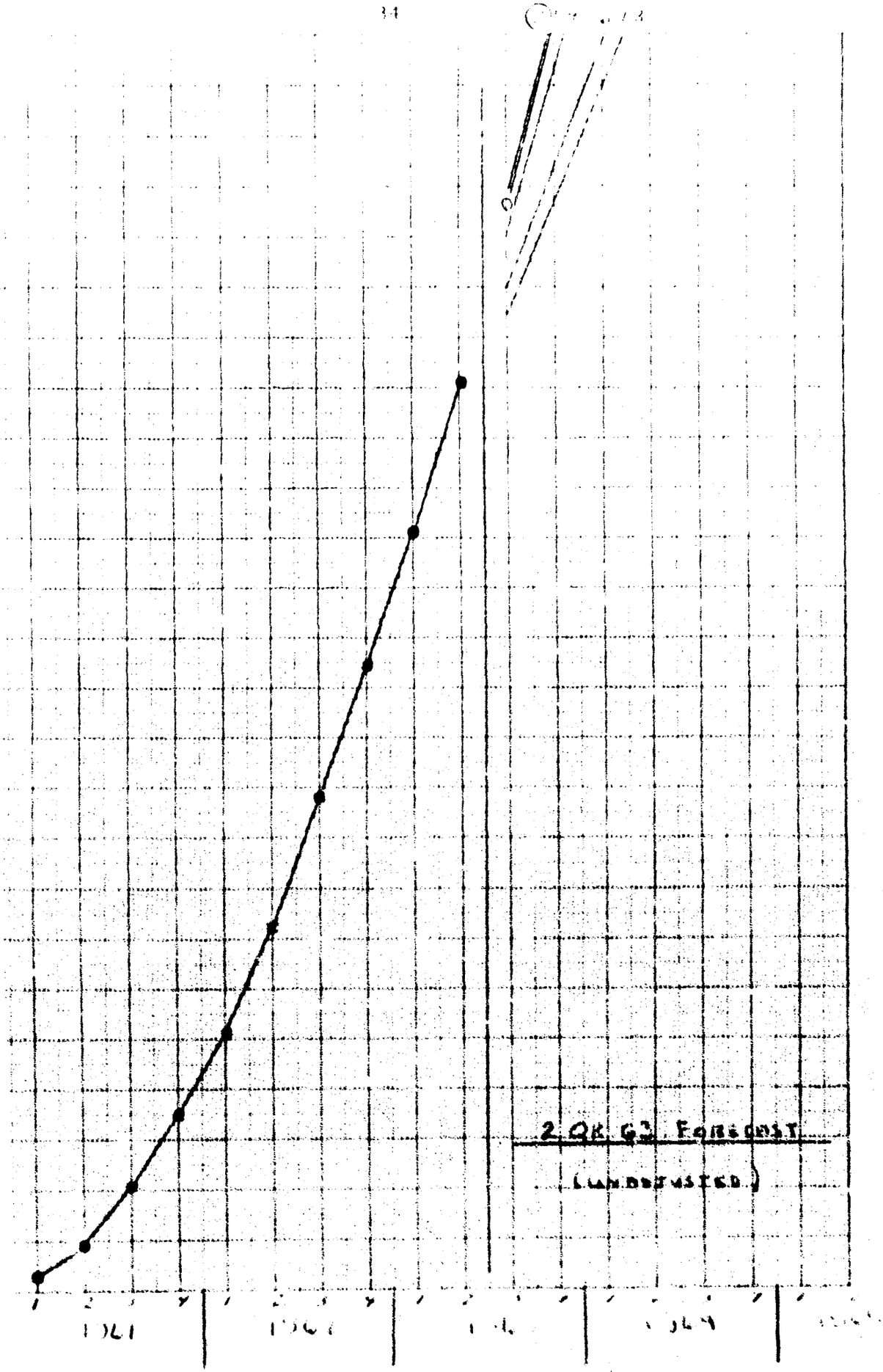
Graphical representation of the cost forecasts illustrated in Appendix I.

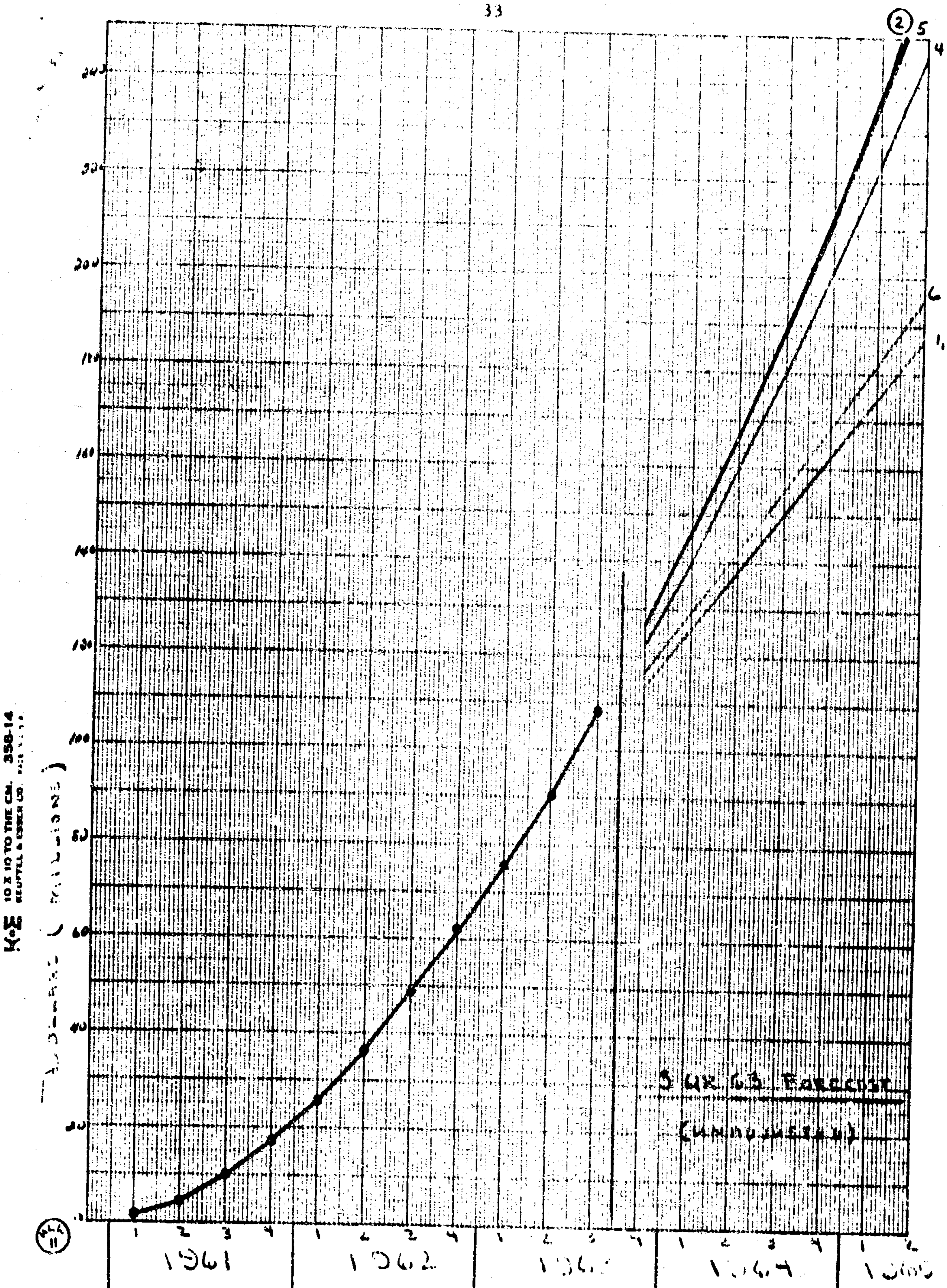
The graphs depict the six cost forecast with the selected cost forecast circled.

LEGEND:

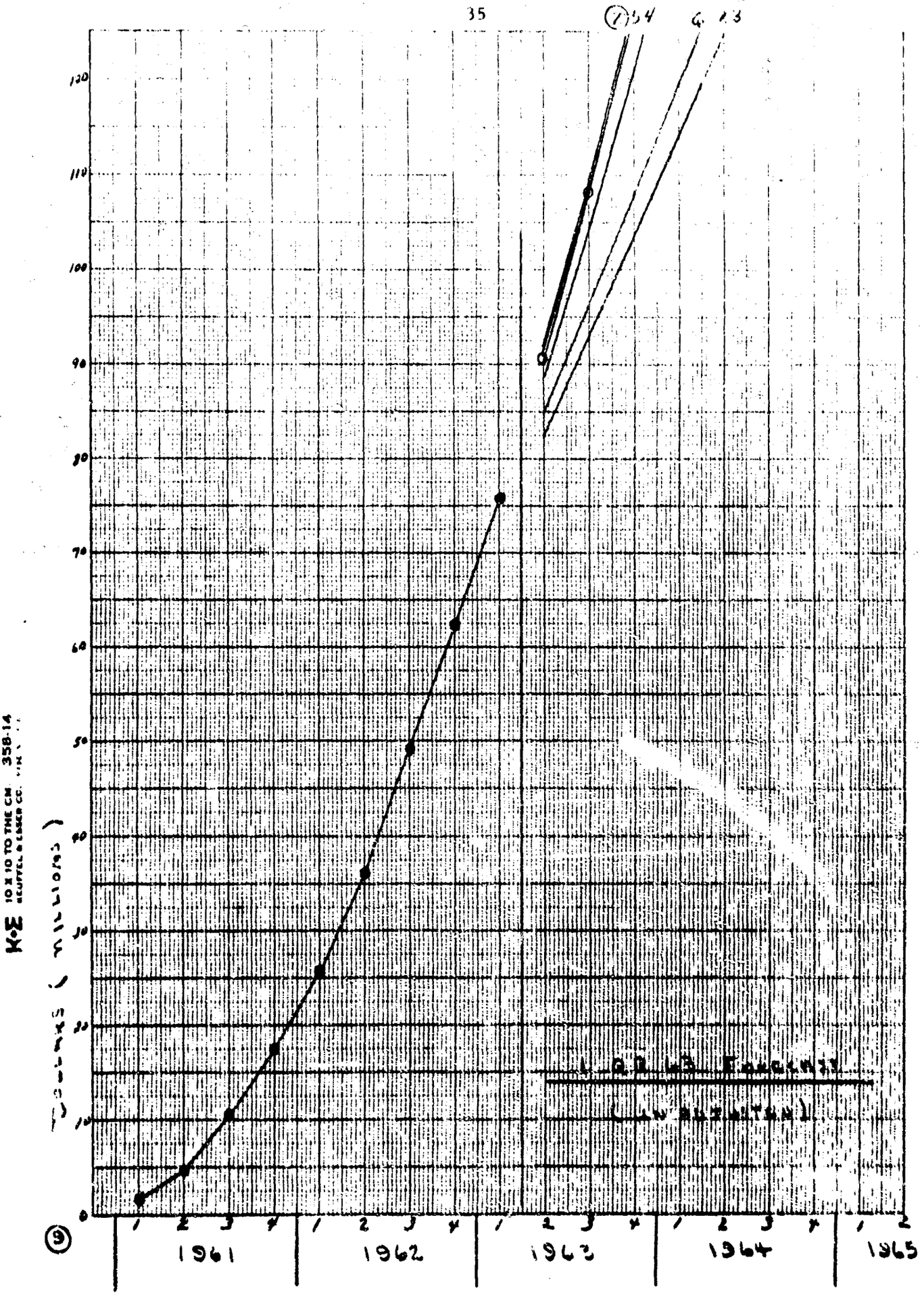


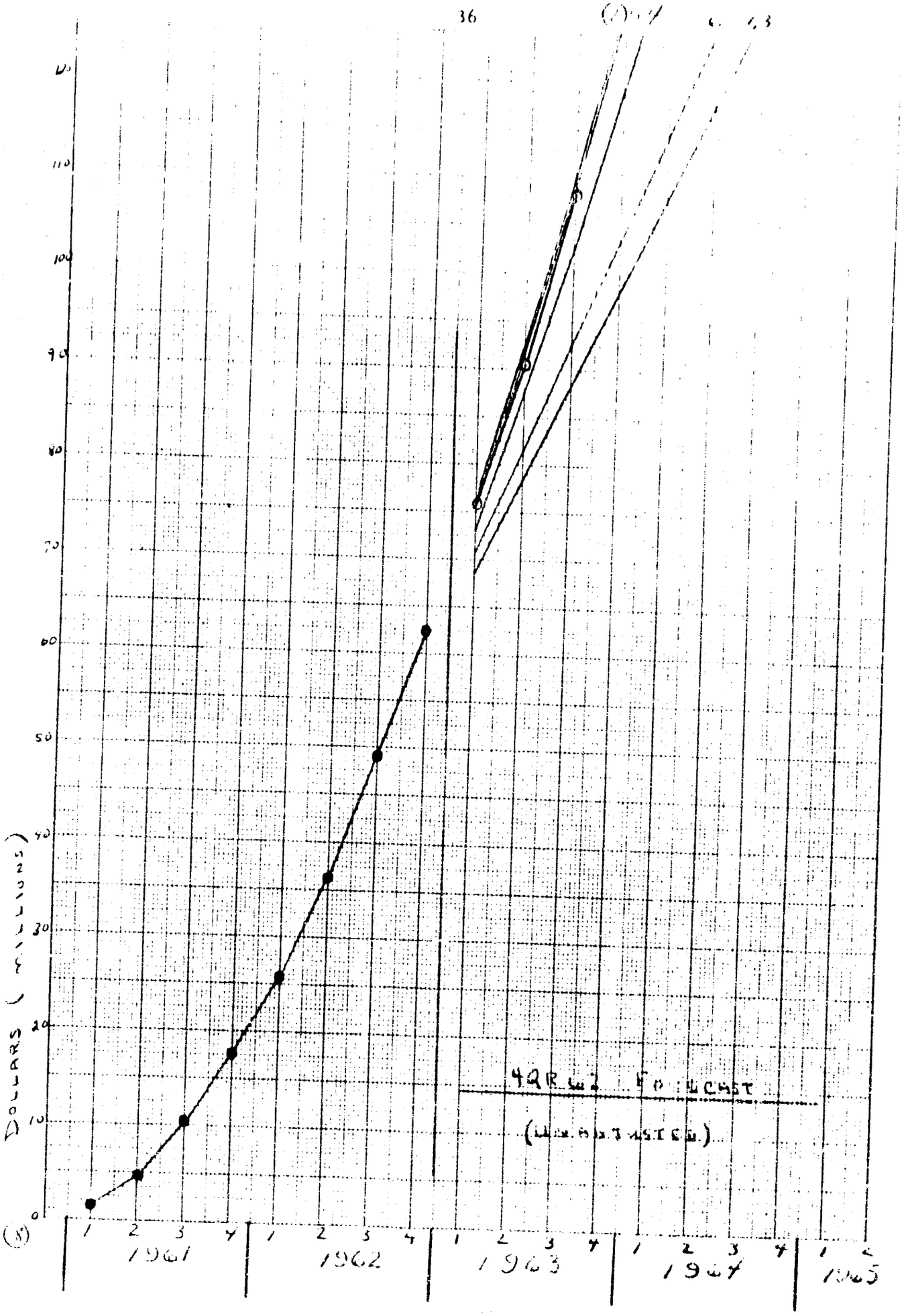
Actual cost data used to make forecast
ACE cost forecasts based upon actual data.
Subsequent actual cost data

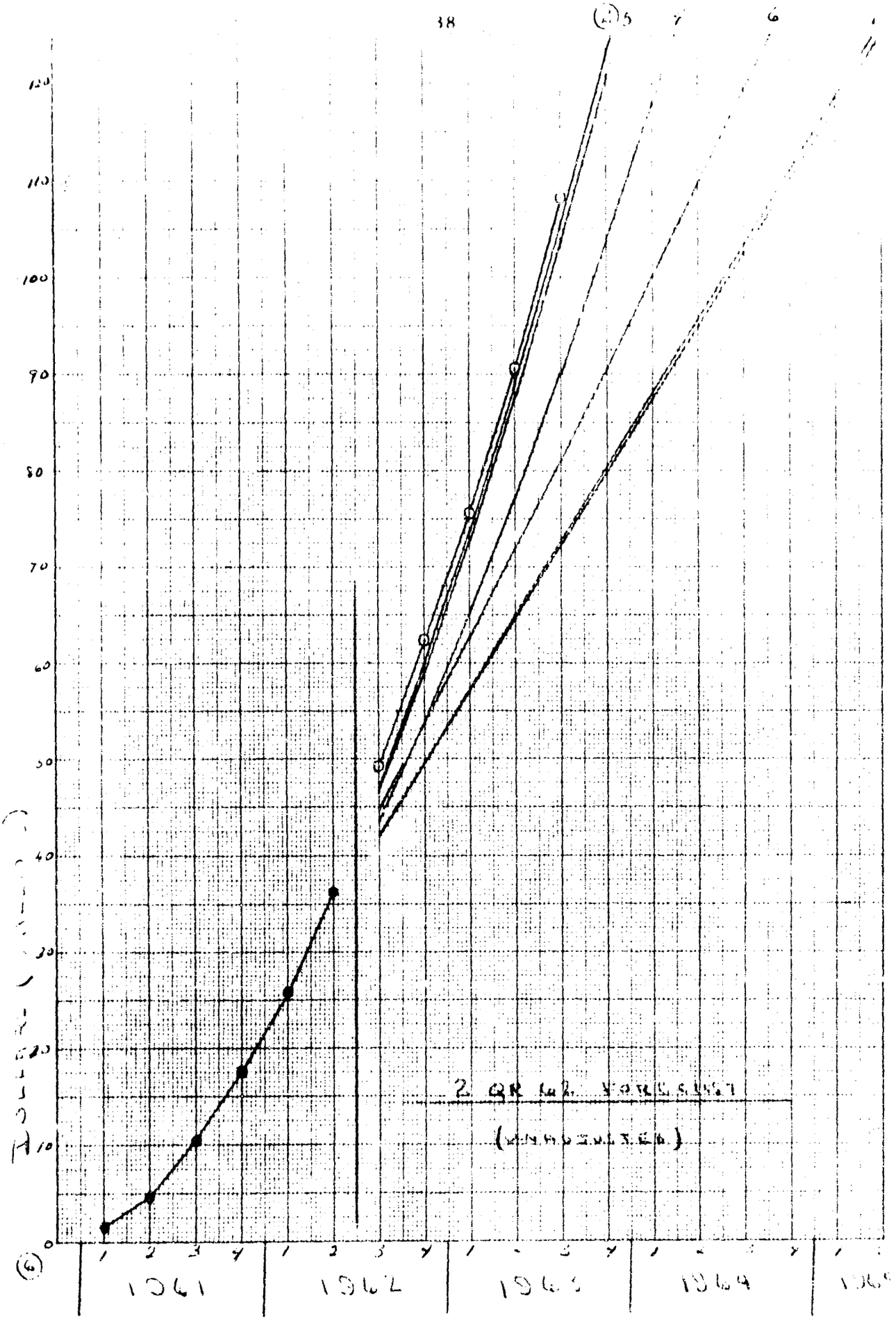

2 QK 63 FORECAST
(UNDERWRITER)

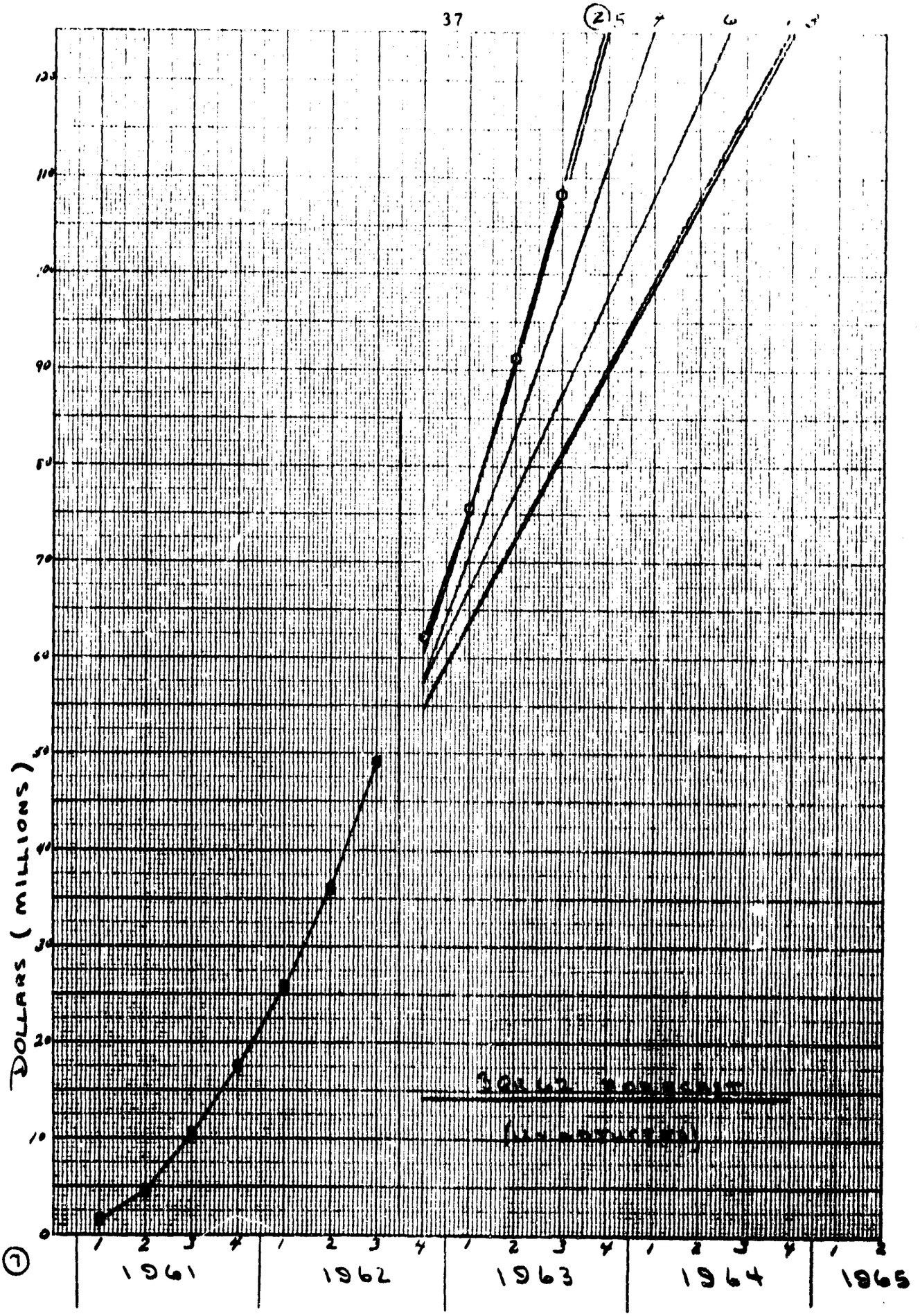


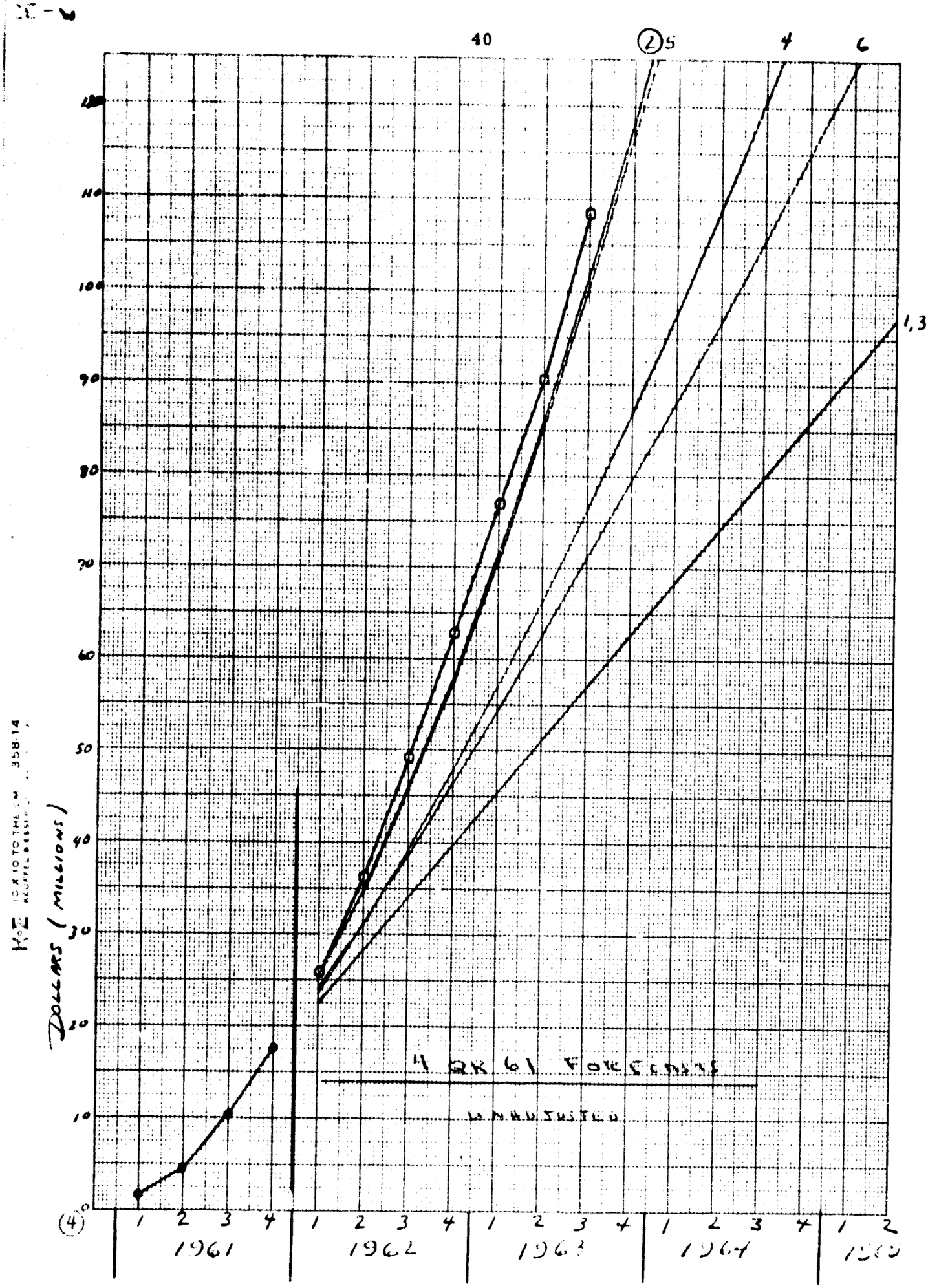
1961
1962
1963
1964
1965

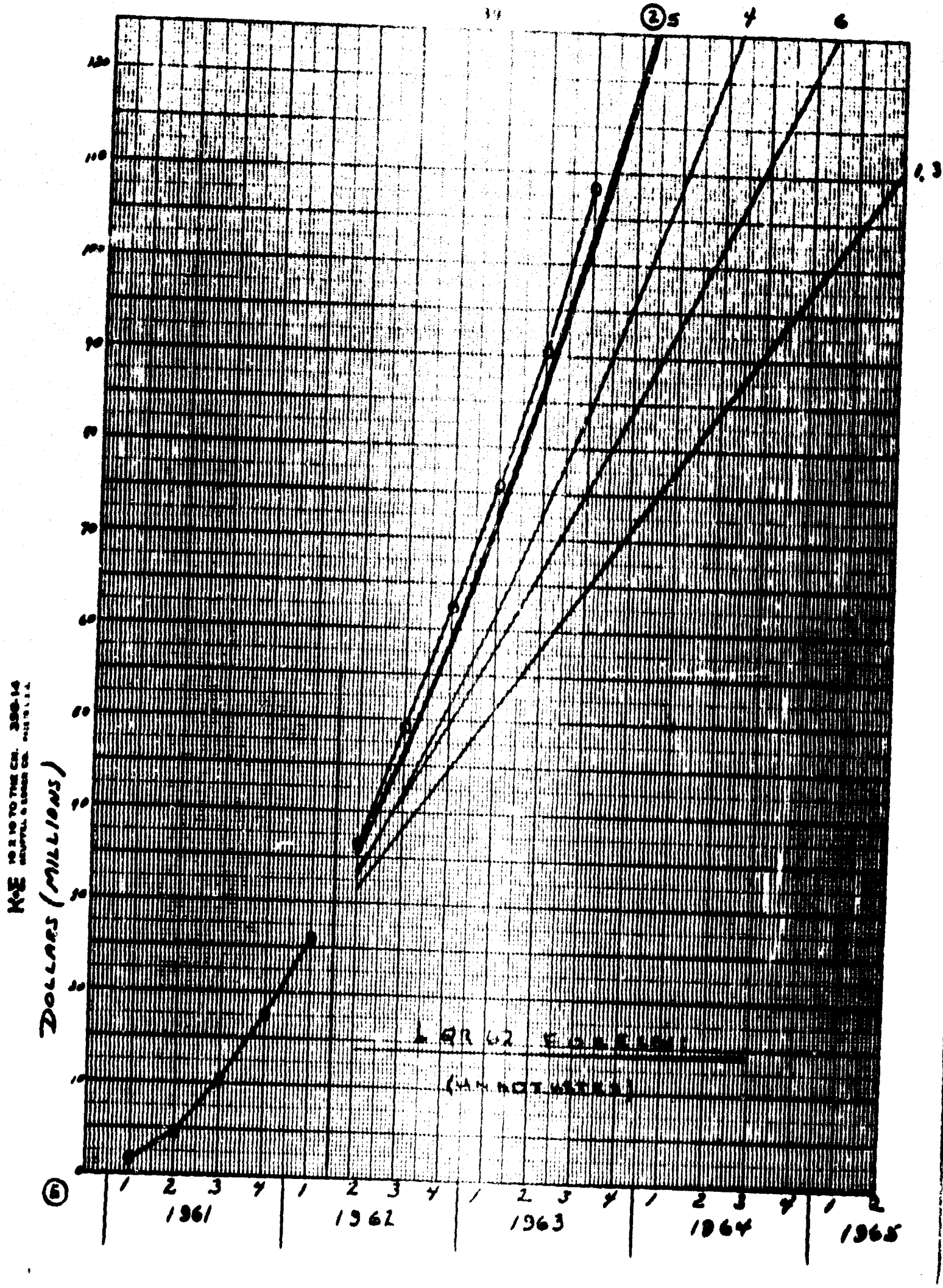

(1) 54
4. 23
120
110
100
90
80
70
60
50
40
30
20
10
0
1961
1962
1963
1964
1965
K&E 10 X 10 TO THE CM 358-14


DOLLARS (BILLIONS)
0
10
20
30
40
50
60
70
80
90
100
110
120
1961
1962
1963
1964
1965
1 2 3 4


120
110
100
90
80
70
60
50
40
30
20
10
0
1961
1962
1963
1964
1965


DOLLARS (MILLIONS)
0
10
20
30
40
50
60
70
80
90
110
1961
1962
1963
1964
1965
1 2 3 4


40
5
4
6
1,3
DOLLARS (MILLIONS)
120
110
100
90
80
70
60
50
40
30
20
10
0
1961
1962
1963
1964
1965
1 2 3 4


DOLLARS (MILLIONS)
1961
1962
1963
1964
1965
5
6